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ABSTRACT

This report discusses trends in the physics academic workforce and the implications of these trends for the future academic job market. Data are from a survey of physics departments that was completed by 722 departments, a response rate of 94%. The number of physics faculty increased almost 5% since 2000, and much of this growth resulted from increases in the number of temporary and nontenure-track faculty. The percentage of women on physics faculties increased in 10% of the total, and more than 60% of physics departments how have at least one woman on their faculty. Women are more likely to be hired as part-time than are men. As in 2000, the estimated retirement rate remained above 3%. The turnover rate of 5.4% was about the same as it had been in 1999. The number of physics faculty members departments were recruiting for 2003 continued to be high, at an estimated 512 tenured or tenure-track recruitments. The number of tenured and tenure-track faculty hired for 2002 is lower than the number who left during 2001. Only one-third of new faculty at PhD departments earned their degrees in the United States within the last 5 years. The remainder either have PhDs from foreign universities, or earned their PhDs more than 5 years ago. (Contains 14 tables and 1 reference.) (SLD)

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2002 PHYSICS ACADEMIC WORKFORCE REPORT

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HIGHLIGHTS

- The number of FTE faculty employed in degree-granting physics departments is 8800, an increase of almost 5% since 2000 **(Table 1)**. Much of this growth resulted from increases in the number of temporary and non-tenure-track faculty **(Table 2)**.
- The percentage of women on physics faculties increased to 10% of the total faculty **(Table 7)**. More than 60% of physics departments now have at least one woman on their faculty **(Figure 2)**, and nineteen PhD departments now have five or more women on their faculty **(Table 6)**.
- Women are more likely to be hired as part-time faculty than men are **(Figure 3)**.
- As in 2000, the estimated annual retirement rate remained above 3%. We estimate that 465 physics faculty retired during the two academic years ending in 2001 and 2002. About one-third of physics departments had someone retire during each of these two years **(Table 8)**.
- The turnover rate of 5.4% was about the same as it had been in 1999. Almost 400 tenured or tenure-track physics faculty members left their positions in 2001 **(Table 9)**.
- The number of physics faculty members for which departments were recruiting for 2003 continues to be high, at an estimated 512 tenured or tenure-track recruitments **(Table 10)**.
- The number of tenured and tenure-track faculty hired for 2002 (353) is lower than the number who left during 2001 (399) **(Tables 9 & 11)**.
- Only one-third of new faculty at PhD departments earned their degrees in the US within the last 5 years. The remainder either have PhDs from foreign universities, or earned their PhDs more than 5 years ago **(Table 14)**.

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The job market for physics faculty is currently undergoing rapid changes. The number of physics faculty increased dramatically between 2000 and 2002. However, most of this increase was due to growth in the numbers of temporary and non-tenure-track faculty. In this respect, physics seems to be following the trend in higher education toward more reliance on non-tenure-track faculty.

Even as the 2002 data collected for this report were being analyzed, states experienced severe budgetary shortfalls that will undoubtedly have serious repercussions for the academic job market. We have heard anecdotes that some smaller state universities have released all of their part-time instructors. Other universities may respond by relying even more on temporary or part-time faculty as they experience hiring freezes imposed by the state that limit their ability to hire tenure-track faculty. And the effect on private universities is largely unknown, but certainly will vary widely from one university to the next.

Nevertheless, as recently as 2002, the job market for academic physicists was relatively healthy. The turnover rate was 5.4%, and departments recruited for about 500 tenured and tenure-track positions for the 2002-2003 academic year.

The data used in this report were collected by the Statistical Research Center of the American Institute of Physics in the spring of 2002. Every two years since 1986, we have surveyed all U.S. degree-granting physics departments about their vacancies, turnover, retirements, and new hires. We also ask about the number of faculty each department has and about their recruitment efforts. Finally, in alternate surveys, we ask either about the number of women faculty, or about the number of minority faculty. In 2002, we obtained data about women on physics faculties.

We sent the questionnaire to all 768 departments that granted at least a bachelor's degree in physics and received 722 replies, for a response rate of 94%. We would like to thank each physics department that responded. Without their help, these data would not be available. Most (but not all) of the numbers in this report are population estimates, where we divided the totals from the survey by the response rate. In this report, we refer to academic years by the year of the spring semester, e.g., 2003 refers to the academic year 2002-2003.

NUMBER OF FACULTY

We asked each physics department to report its number of full-time equivalent (FTE) faculty involved in teaching or research in physics or astronomy on February 1, 2002. In addition to the 722 responses that we received, we were able to estimate the number of FTE faculty for an additional 40 departments using other sources.

This survey does not attempt to count all physicists working in colleges and universities. It does not include postdocs, physicists working in departments that do not grant physics degrees, and physicists who conduct research in university-affiliated institutes but are not included in departments' FTE count. However, the FTE count may include physicists working in physics departments on grants or soft money. In many departments, the number of FTE faculty is different

Table 1. Estimated Number of Full-Time Equivalent Physics Faculty and Average Number of Faculty, 1994, 1998 and 2002

Type of Department		1994	1998	2002
PhD	FTE	4900	5000	5100
	Average	27	27	28
Master's	FTE	800	850	900
	Average	10	12	12
Bachelor's	FTE	2500	2500	2800
	Average	5	5	5.5
Overall	FTE	8200	8350	8800
	Average	11	11	11.5

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Table 2. Percent of Full-Time Equivalent Physics Faculty Who Were Temporary or Non-Tenure-Track, 1998, 2000, 2002

Type of Department	1998 (%)	2000 (%)	2002 (%)
PhD	12	11	14
Master's	12	16	19
Bachelor's	15	19	22
Overall	13	14	17

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from the number of physicists working there. Because of part-time faculty and joint appointments, some departments have a larger number of physicists than their FTE reflects.

We estimate that in the spring of 2002, all degree-granting physics departments in the US employed 8800 FTE faculty (**Table 1**). This represents a five percent increase over 2000, which is a much larger increase than we have ever seen. Previously, the number of faculty has only increased by about one-half percent per year. And between 1998 and 2000, the number of physics faculty remained essentially the same. The current five percent increase, however, is due mostly to an increase in the number of temporary and non-tenure track faculty.

As with other academic disciplines (US Dept. of Education, 2002), physics is beginning to rely more on non-tenure-track and temporary faculty. The percentage of temporary and non-tenure-track faculty in physics departments has been consistently growing since 1998 (**Table 2**). The growth in temporary and non-tenure-track faculty between 1998 and 2000 largely occurred in departments that do not grant PhDs in physics. Between 2000 and 2002, however, the contingent of temporary and non-tenure-track faculty grew at both graduate and undergraduate departments. Since 2000, temporary and non-tenure-track faculty increased from 11% to 14% of the FTE at PhD departments. Temporary and non-tenure-track faculty now make up 19% of the FTE at master's departments and 22% of the FTE at bachelor's departments.

At PhD and master's departments, almost all of the non-tenure-track FTE faculty are in institutions that grant tenure. At bachelor's departments, more than 70% of non-tenure-track FTE faculty are in institutions that grant tenure. The remainder are non-tenure-track because their institutions do not have a tenure system. In 2002, twenty departments reported not having a tenure system at their institution. Most of

Table 3. Distribution of Physics Faculty by Department Type, 2002

	Type of Department		
	PhD	Master's	Bachelor's
Number of Departments	182	73	513
Median Number of Faculty	24	10	4
Number of Faculty in Smallest Third of Departments	3.5-19	4-9	≤3
Number of Faculty in Middle Third of Departments	19.5-32	9-14	3-6
Number of Faculty in Largest Third of Departments	32-79	14-35	6-36

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Table 4. Number of Bachelor's-Granting Departments by Number of Full-Time Equivalent (FTE) Faculty and by Cumulative Number of Bachelor's Awarded 1999-2001

		Cumulative number of bachelor's awarded 1999-2001					
		None	1 - 5	6 - 9	10 - 14	15 or more	Overall
Number of FTE faculty	2 or less	11	56	22	4	2	95
	2.1 - 3	1	31	20	16	6	74
	3.1 - 4	2	25	16	13	13	69
	4.1 - 6	2	23	26	19	36	106
	6.1 - 9	1	12	25	23	34	95
	9.1 or more	1	7	11	8	24	51
	Overall	18	154	120	83	115	490

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these are departments that do not grant graduate degrees in physics.

It is perhaps inaccurate to speak of growth in "temporary and non-tenure-track faculty" at the same time because some departments are coming to rely on temporary faculty while others are increasing their use of non-tenure-track faculty. For example, departments that grant graduate degrees increased mostly in terms of non-tenure-track faculty, rather than in terms of temporary faculty. This perhaps reflects graduate departments' larger numbers of research faculty, who sometimes do not have tenure status. On the other hand, departments that grant bachelor's degrees increased mostly in terms of temporary, rather than non-tenure-track faculty. These departments use temporary faculty as part-time or temporary teachers rather than researchers.

Of the 513 physics departments that grant a bachelor's as their highest physics degree, more than one-third have three or fewer faculty (**Table 3**). In fact, there are almost as many of these small bachelor's degree-granting departments as there are departments

Table 5. Number of PhD-Granting Departments by Number of Full-Time Equivalent (FTE) Faculty and by Cumulative Number of Bachelor's Awarded, 1999-2001

		Cumulative number of bachelor's awarded 1999-2001					
		1 - 9	10 - 14	15 - 29	30 - 44	45 or more	Overall
Number of FTE faculty	15 or less	8	6	9	1	2	26
	15.1 - 25	11	21	21	6	3	62
	25.1 - 39.9	2	7	20	8	16	53
	40 or more	1	1	3	11	17	33
	Overall	22	35	53	26	38	174

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that grant PhDs in physics. Nevertheless, because their faculties are so large, PhD departments employ the largest number of physicists (5100) and have a median number of 24 faculty per department, up from 22 per department in 2000.

Despite having smaller faculties, bachelor's departments are very efficient at producing bachelor's degree recipients. About one-fourth of bachelor's departments produced 15 or more bachelors during the three year period 1999-2001, even though 80% of these have 9 or fewer FTE faculty (**Table 4**). On the other hand, one-third of PhD departments produced fewer than 15 bachelors from 1999-2001, even though the majority of these have more than 15 FTE faculty (**Table 5**).

WOMEN FACULTY

The percentage of women on physics faculties continues to increase. Our earliest data on women physics faculty date from 1985 and were collected from PhD departments only. At that time, 55 percent of PhD departments had no women at all on their faculties (**Figure 1**). By 2002, this percentage was down to 14%. Almost all PhD departments had at least one woman on the faculty in 2002 (**Figure 2**). Nineteen departments had five or more women in 2002 (**Table 6**). In 1998, 17 departments had four or more women, but by 2002, 36 departments had four or more women.

We have data on women at both graduate and undergraduate departments since 1994, when only about two-fifths of physics departments had any women on their faculty. By 2002, however, more than 60% of all physics departments had at least one woman on their faculty. The percentage of departments with at least one female faculty member is lowest among the bachelor's departments. This is probably because most of these undergraduate departments have very few faculty members (with a median of four faculty per department), thus decreasing the likelihood that any of their faculty members are women.

Figure 1. Number of Women Faculty in PhD Physics Departments, 1985 and 2002

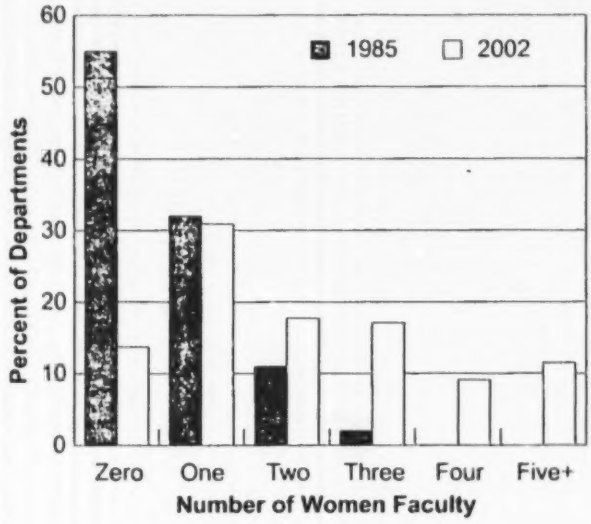

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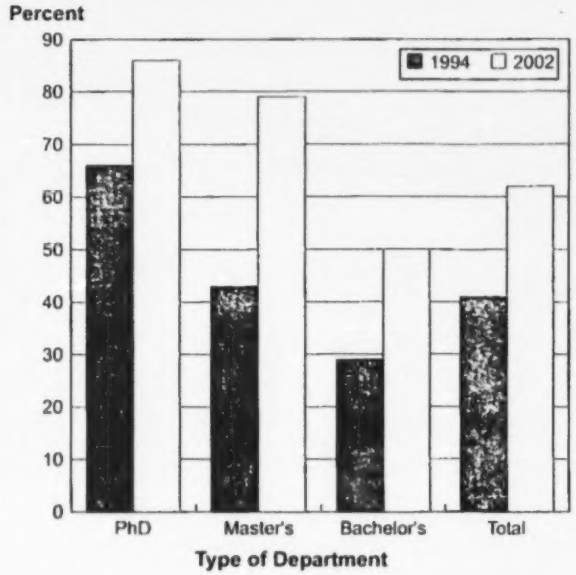
Figure 2. Percent of Physics Departments with Women at Any Rank, 1994 and 2002



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Not only has the percentage of departments that have women increased, but the percentage of physics faculty members who are women also has increased. In 1994, just six percent of physics faculty members were women. By 2002, that percentage had increased to ten percent (**Table 7**). Although the percentage of full professors who are women is still very low, it should be noted that most full professors of physics earned their PhDs in the early 1970s, when a similarly small percentage of PhDs went to women. One of the most encouraging signs is that 16% of the assistant professors of physics are women, which is higher than the current percentage of PhDs awarded to women (13%). Perhaps women are more likely to take jobs in academia rather than in industry.

On the other hand, the percentage of women faculty members who are not in the tenure-ladder ranks of full, associate, and assistant professor has been increasing, and reached fifteen percent by 2002 (**Table 7**). In addition, women are more likely to be on faculties at departments that do not grant graduate degrees in physics. Although fewer bachelor's departments have women faculty, the percentage of women faculty members is higher at bachelor's departments (14%) than at PhD departments (7%).

Table 6. PhD Physics Departments with Five or More Women on Faculty, 2002

California at Santa Barbara, University of
California Institute of Technology
Cornell University
Harvard University
Illinois at Urbana-Champaign, University of
Kansas, University of
Louisiana State University at Baton Rouge
Massachusetts Institute of Technology
New Hampshire, University of
North Carolina State University
Northwestern University
Notre Dame, University of
Pennsylvania State University
Pittsburgh, University of
Rutgers University at Brunswick
Tennessee at Knoxville, University of
Washington, University of
Wisconsin at Madison, University of
Wisconsin at Milwaukee, University of

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Table 7. Percent of Faculty Positions in Physics Held by Women, 1994, 1998 and 2002

		1994 (%)	1998 (%)	2002 (%)
Academic Rank	Full Professor	3	3	5
	Associate Professor	8	10	11
	Assistant Professor	12	17	16
	Other Ranks	8	13	15
Type of Department	PhD	5	6	7
	Master's	7	9	13
	Bachelor's	7	11	14
	Overall	6	8	10

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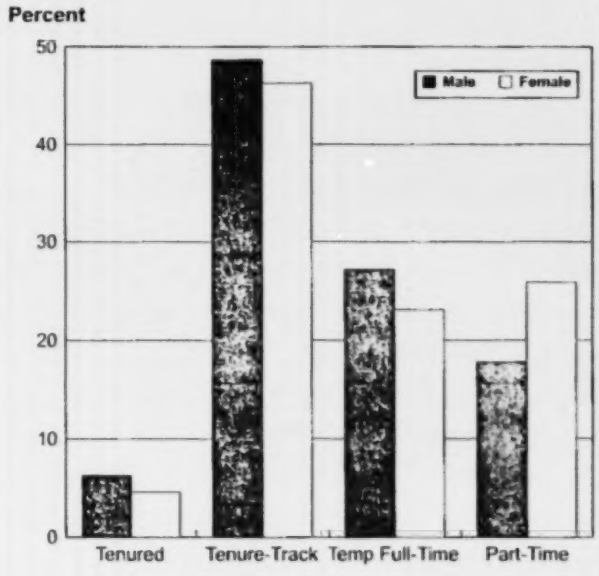
Among newly hired faculty, women are more likely than men to be hired as part-time rather than as tenured, tenure-track, or even as temporary full-time (**Figure 3**). When looking at position title, newly hired women are more likely than men to be instructors or adjunct faculty (**Figure 4**). Meanwhile, men are more likely to be hired as full, associate, or assistant professors, or as visiting or research professors.

These data show that while women are holding a larger share of the physics faculty, they are also more likely to be faculty at departments that do not grant graduate

Figure 3. Employment Status of New Physics Faculty by Gender, 2002



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degrees in physics, and they are more likely to be hired as part-time, and not as ladder-ranked professors.

TURNOVER, RETIREMENTS, RECRUITMENTS & NEW HIRES

We have seen that while the number of FTE faculty has increased, the increase is driven by growth in temporary, non-tenure-track faculty. Further evidence of this can be found by examining the number of tenured and tenure-track faculty for which departments recruited and the number of these faculty members who were actually hired. Both of these numbers are essentially unchanged since 2000 despite the five percent increase in number of FTE faculty. Also essentially unchanged since 2000 are retirement and turnover rates for tenured and tenure-track faculty.

Figure 4. Current Positions of New Physics Faculty by Gender 2002

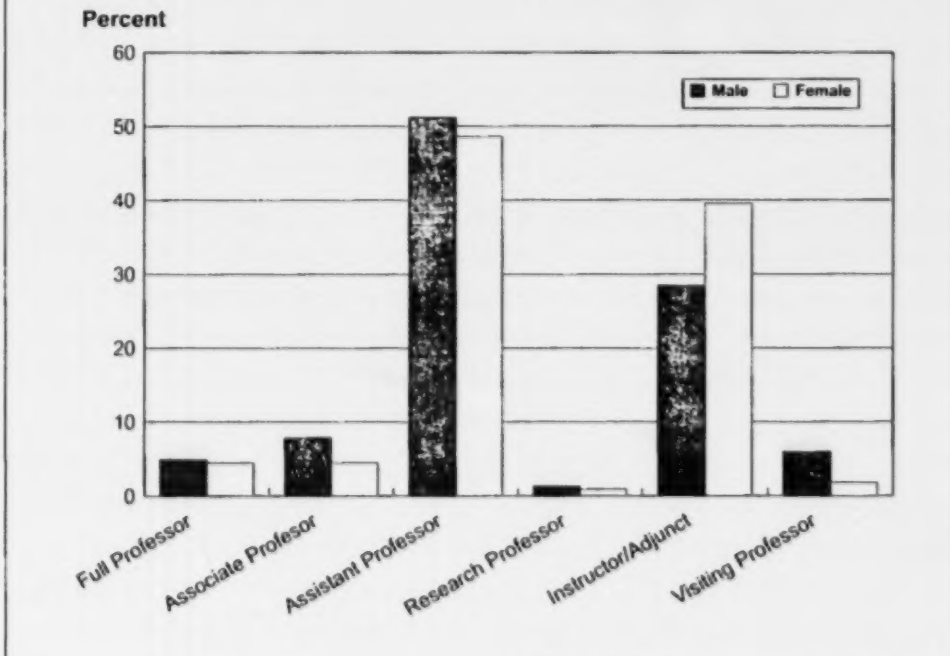

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Table 8. Estimated Annual Retirement Rates for Physics Faculty During Two Academic Years, 2001 and 2002

	Type of Department			
	PhD	Master's	Bachelor's	Overall
Estimated Number of Retirements	230	59	176	465
Estimated Percent of Departments with Retirements per Year	55	39	23	32
Estimated Annual Retirement Rate	2.6	4.0	3.9	3.1

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The retirement rate in 2000 was 3.3 percent, which was a record high. In 2002, the retirement rate for physics faculty was 3.1 percent (**Table 8**). Although the retirement rate was high, only about 230 physics faculty retired during each of the two academic years ending in 2001 and 2002. Despite the fact that the physics faculty are aging, retirement seems to have leveled off at around 3% per year, and not that many openings are created in physics due to retirements alone. The anticipated budgetary crisis may mean that many retirement openings will simply go unfilled, at least for the near future. Even after retirement, many physics faculty return part-time to the classrooms, and many departments may come to rely more and more on this type of arrangement to save money.

Overall turnover also continued at about the same rate as in 1999 (**Table 9**). In the spring of 2002, we asked physics departments how many tenured and tenure-track faculty members had left during the academic year ending in 2001. As in 1999, a little more than 5% of tenured and tenure-track faculty left their positions whether through changing jobs, being denied tenure, retiring, or dying. We estimate that in 2001, just under 400 tenured or tenure-track faculty positions were vacated. This includes the approximately 230 faculty who retired during 2001.

Once a position is vacated, the department usually begins recruitment efforts in the following fall semester. Then the new faculty member usually does not start working until a year later. We estimate that during the 2001-02 academic year, 42% of departments recruited for 512 new tenured and tenure-track faculty members to start in the academic year 2002-03 (**Table 10**). This is almost the same number (509) for which departments recruited for the academic year ending in 2001. Not all of these tenured

Table 9. Estimated Tenured and Tenure-Track Physics Faculty Turnover, 1999 and 2001

	Type of Department			
	PhD	Master's	Bachelor's	Overall
Percent of Departments with Vacancies, 2001	59	40	26	36
Estimated Vacant Positions, 2001	187	50	162	399
Estimated Turnover, 2001	4.3	6.8	7.2	5.4
Estimated Turnover, 1999	4.2	5.9	7.3	5.3

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Table 10. Physics Departments Recruiting New Faculty Members for 2003

	Type of Department			
	PhD	Master's	Bachelor's	Overall
Percent of Departments Recruiting Tenured or Tenure-Track	74	53	29	42
Number of Tenured or Tenure-Track Recruitments	277	54	181	512
Percent of Departments Recruiting Temp. Full-Time Faculty	12	18	10	11
Number of Temp. Full-Time Recruitments	45	17	66	128

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and tenure-track positions will be filled, as departments often do not find the right candidate or may even lose funding for the position after the recruitment process has begun. Considering the anticipated budgetary crisis in many states, the number of unfilled positions is likely to be quite high for the 2003-04 academic year.

A small, but significant, number of physics departments recruited for temporary full-time positions for 2002-03. About 10% of departments recruited for 128 temporary full-time positions, and 45 of these positions were at PhD departments. These temporary full-time positions are important, as they often lead into tenure-track appointments more frequently than part-time appointments do. However, these tenure-track appointments may not be at the same department as the temporary full-time position.

The number of new faculty hired is usually less than the number of faculty for which departments recruit. For the last two surveys, we have seen recruitments at around 500 tenured and tenure-track openings, while new hires were only around 350. In 2000, departments hired 335 new tenured and tenure-track faculty, and in 2002, this number was 353 (**Table 11**). In fact, the number of new hires is actually closer to the number of vacancies (just under 400) than to the number of recruitments. Departments may recruit for positions but not fill them for many reasons, including loss of funding or not finding the right candidates. Therefore, even though the number of recruitments for 2003 was higher than the number of new hires for 2002, we do not expect the number of new tenured and tenure-track hires to increase in the near future, especially given the budgetary problems that many universities are beginning to face.

Tenured and tenure-track hires account for only about half of all new hires. When we include part-time and temporary positions, there were more than 330 additional new hires for 2001-02. Altogether, 53% of physics departments hired at least one new faculty member. Although the number of part-time and

Table 11. Estimated Number of Physics Faculty Hired, 2002

	Type of Department			
	PhD	Master's	Bachelor's	Overall
All Faculty	274	71	342	687
Tenured and Tenure-Track	197	32	124	353
Percent of Depts. Hiring any Faculty	72	59	45	53
Percent of Depts. Hiring Tenured and Tenure-Track	60	34	20	31

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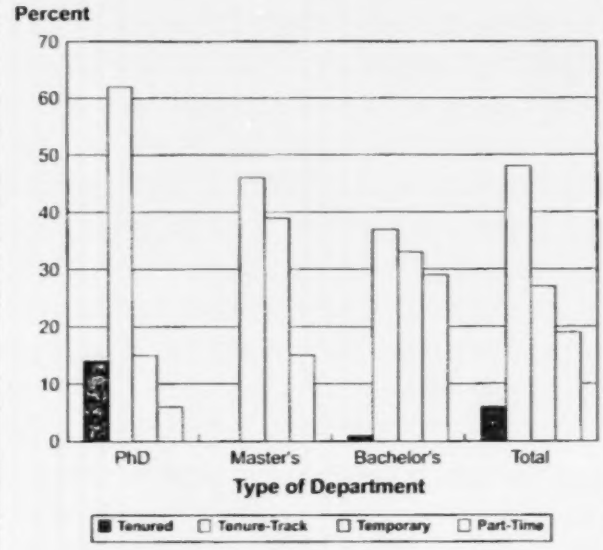
Figure 5. Employment Status of New Physics Faculty, 2002



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temporary new hires is about the same as it was in 1999-2000, we may see temporary and part-time new hires increase if departments come to rely more on these types of positions.

WHO IS HIRED?

Physics departments tend to be very selective about whom they hire as new faculty members. Just like other employers, departments want to find the "right" fit for their program. Hiring a physics faculty member at many departments is extremely expensive, due to "start up" costs for experimental physicists. For job seekers, this means that new PhD recipients are seldom hired directly into tenure-track jobs, especially at graduate departments.

In fact, about half of the faculty hired at physics departments are not tenured or tenure-track (**Figure 5**), but are temporary and part-time. PhD departments reported hiring a larger percentage of tenured and tenure-track faculty members than other types of departments. And master's and bachelor's departments reported hiring larger percentages of temporary and part-time faculty than PhD departments.

At all departments, the most common position title for new faculty who started in 2002 was assistant professor (**Table 12**). Instructors and adjuncts also accounted for a sizeable percentage of new hires. Compared to 2000, bachelor's departments greatly increased the percentage of new hires who were instructors and adjuncts. In 2000, instructors and adjuncts accounted for about one-fourth of new hires at the bachelor's level. By 2002, forty percent of the

Table 12. Current Positions of New Physics Faculty, 2002

	Type of Department		
	PhD (%)	Master's (%)	Bachelor's (%)
Full Professor	10	0	1
Associate Professor	10	8	6
Assistant Professor	55	52	47
Research Professor	3	0	0
Instructor/Adjunct	17	38	40
Visiting Professor	5	3	6

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new hires at bachelor's departments were instructors or adjuncts. Likewise, the percentage of new hires at the assistant professor level decreased at bachelor's schools from 63% in 2000 to less than 50% in 2002.

The postdoc has become a requirement for any sort of non-temporary appointment in academia. Even at departments that do not grant graduate degrees in physics, about one-fourth of all new tenured and tenure-track faculty members had been postdocs at their previous jobs (**Table 13**). At PhD departments, this proportion is almost half of new faculty members. Departments also show a preference for experienced faculty. Faculty members who were tenured or tenure-track at other institutions accounted for sizeable percentages of new faculty at both PhD and bachelor's departments.

Table 13. Previous Positions of New Physics Faculty, 2002*

Type of Department			
PhD (%)		Bachelor's (%)	
Postdoc	47	Postdoc	23
Research Scientist	29	Tenured or Tenure-Track Prof.	23
Tenured or Tenure-Track Prof.	20	Visiting Prof.	15

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*Includes permanent non-tenured faculty at schools without tenure, and tenured and tenure-track faculty at other schools.

For tenured and tenure-track positions, PhD departments also tended to hire faculty members who had previously worked as research scientists, perhaps in industry or government labs. These faculty members were probably hired based on their research agendas. Bachelor's departments also hired a sizeable group of faculty members who had previously been visiting professors, emphasizing the importance of these temporary appointments as a path to tenure-track jobs at undergraduate institutions. Visiting professors may be hired at these institutions because of their teaching experience.

Many physics departments have found that when hiring tenured and tenure-track faculty, experienced physicists suit their needs best. As **Table 14** shows, about one-third of new hires at both bachelor's and PhD departments received their PhD in the US more than five years ago. Most of these faculty members had previously worked at other academic institutions. However, less-experienced faculty members do obtain tenured and tenure-track jobs. In fact, a majority of new hires at bachelor's departments and one-third of new hires at PhD departments received their PhDs at US institutions less than five years ago, but probably most of these had been postdocs for a few years. PhD departments also hired a large percentage of faculty members who earned their PhDs outside the US, although this is less common at bachelor's departments.

Table 14. Backgrounds of New Physics Faculty, 2002*

	Type of Department	
	PhD (%)	Bach (%)
Earned PhD in US within last 5 years	34	55
Earned PhD outside US, any year	30	13
Earned PhD in US > 5 years ago		
Previous Employer		
US Academic Institution	29	29
Industry, National Lab, Other	7	3

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*Includes permanent non-tenured faculty at schools without tenure, and tenured and tenure-track faculty at other schools.

CONCLUSION

The academic workforce in physics is undergoing some changes, but some things remain the same. While the number of tenured and tenure-track openings remain the same as in 2000, the number of temporary and non-tenure-track faculty is increasing. Physics is subject to the same economic realities as other disciplines, and is beginning to rely more on temporary and non-tenure-track faculty. Thankfully, physics has not yet experienced a loss of tenured and tenure-track faculty.

Another major change in the physics academic workforce is the increasing number of physics departments that have women on their faculties. Likewise, an increasing percentage of physics faculty members are women. Advocates for women in physics have long been working for change in this area, and while the percentages of women faculty members are still low, they are increasing. And for the future, we see that a greater percentage of assistant professors are women than the percentage of women currently earning PhDs in physics. However, some things for women continue to be difficult, as evidenced by the larger proportions of women working at departments that do not grant graduate degrees in physics, and by the larger proportions of women hired as part-time in instructor or adjunct positions.

As we have emphasized many times throughout this report, the budgetary crisis in many states will have as yet unforeseen consequences on the academic job market for physics in the next few years. We will address this issue in our 2004 report.

REFERENCE

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